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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/620,995	07/16/2003	Jung-Hun Seo	5649-1121	8840
20792	7590	11/26/2004	EXAMINER	
MYERS BIGEL SIBLEY & SAJOVEC			SCHILLINGER, LAURA M	
PO BOX 37428			ART UNIT	
RALEIGH, NC 27627			PAPER NUMBER	
			2813	

DATE MAILED: 11/26/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/620,995

Applicant(s)

SEO ET AL.

Examiner

Laura M Schillinger

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 26 May 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-31 is/are pending in the application.
- 4a) Of the above claim(s) 20-31 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 5/26/04.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

- I. Claims 1-28, drawn to a method, classified in class 438, subclass 643.
- II. Claims 29-31, drawn to a device, classified in class 257, subclass 750.

The inventions are distinct, each from the other because of the following reasons:

Inventions I and II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the higher carbon concentration may be made by a plasma treatment or a doping process.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, restriction for examination purposes as indicated is proper.

Because these inventions are distinct for the reasons given above and the search required for Group I is not required for Group II and vice versa, restriction for examination purposes as indicated is proper.

This application contains claims directed to the following patentably distinct species of the claimed invention:

Group I:

Species 1, claims 1-19, pertaining to a method including a plasma treatment;

Species 2, claims 20-28, pertaining to a method including decreasing carbon concentration.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, there is no generic.

Applicant is advised that a reply to this requirement must include an identification of the species that is elected consonant with this requirement, and a listing of all claims readable thereon, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise include all the limitations of an allowed generic claim as provided by 37 CFR 1.141. If claims are added after the election, applicant must indicate which are readable upon the elected species. MPEP § 809.02(a).

Should applicant traverse on the ground that the species are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing the species to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the inventions unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103(a) of the other invention.

During a telephone conversation with Robert Meeks on 11/19/04 a provisional election was made without traverse to prosecute the invention of Species 1, claims 1-19. Affirmation of this election must be made by applicant in replying to this Office action. Claims 20-31 are

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withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1-10, 12-19 are rejected under 35 U.S.C. 102(e) as being anticipated by Lee et al ('769).

1. A method of forming an aluminum structure in a microelectronic article, the method comprising:

forming a recess in a microelectronic substrate (Col.7, lines: 25-30);

forming a metal-containing layer conforming to a surface of the recess and to an adjacent surface of the substrate(Col.7, lines: 45-60);

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plasma treating the substrate having the metal-containing layer thereon (Col.8, lines: 10-15); and depositing aluminum on the metal-containing layer to form an aluminum layer thereon (Col.8, lines: 45-55).

2. The method of Claim 1, wherein depositing aluminum comprises depositing the aluminum at a temperature of about 160 C or less (Col.4, lines: 1-5).

3. The method of Claim 1, wherein forming a recess comprises forming a contact hole in an insulating layer of the substrate that exposes an underlying conductive region of the substrate (Col.7, lines: 25-30).

4. The method of Claim 1, wherein the recess has an aspect ratio greater than about 1 (Abs., lines:1-25).

5. The method of Claim 1, wherein forming a metal-containing layer comprises forming the metal-containing layer by metal organic chemical vapor deposition (MOCVD) (Col.4, lines: 60-65).

6. The method of Claim 5, wherein the metal-containing layer is a barrier metal layer (Col.7, lines: 45-60).

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7. The method of Claim 6, wherein the metal-containing layer comprises at least one material selected from a group consisting of titanium nitride (TiN), tantalum nitride (TaN), titanium silicon nitride (TiSiN) and tantalum silicon nitride (TaSiN) (Col.7, lines: 45-60).

8. The method of Claim 1, wherein depositing aluminum comprises depositing aluminum on the metal-containing layer by chemical vapor deposition (CVD) using a methylpyrrolidine alane (MPA) source gas (Col.4, lines: 10-15).

9. The method of Claim 1, wherein plasma treating the substrate comprises plasma treating using at least one gas selected from a group consisting of argon (Ar), hydrogen (H₂), nitrogen (N₂), oxygen (O₂), nitrous oxide N₂O and ammonia (NH₃) (Col.8, lines: 10-15).

10. The method of Claim 1, wherein plasma treating the substrate comprises plasma treating the substrate at a pressure in a range from about 1 Torr to about 6 Torr (Col.11, lines: 35-40).

12. The method of Claim 1, wherein plasma treating the substrate comprises plasma treating the substrate for about 60 seconds (Col.8, lines: 10-15).

13. The method of Claim 1: wherein forming a metal-containing layer is preceded by forming an ohmic layer conforming to an interior surface of the recess and to the adjacent surface of the insulating layer (Col.7, lines: 45-60); and

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wherein forming a metal-containing layer comprises forming the metal-containing layer on the ohmic layer (Col.7, lines: 45-60).

14. The method of Claim 13, wherein the ohmic layer comprises at least one of titanium (Ti) or tantalum (Ta) (Col.7, lines: 55-60)..

15. The method of Claim 1:

wherein forming a metal-containing layer comprises forming a first metal-containing layer (Col.7, lines: 45-60);

wherein plasma treating comprises plasma treating the substrate having the first metal-containing layer thereon (Col.8, lines: 10-16);

wherein depositing aluminum on the metal-containing layer comprises depositing aluminum on the first metal-containing layer to form a first aluminum layer thereon (Col.8, lines: 50-60); and

wherein the method further comprises:

forming a second metal-containing layer conforming to an interior surface of the recess and to an adjacent surface of the insulating layer (Col.7, lines 45-60);

plasma treating the substrate having the second metal-containing layer thereon (Col.8, lines: 10-16); and

depositing aluminum on the second metal-containing layer at a temperature of about 160 C or less to form a second aluminum layer thereon (Col.4, lines: 1-5).

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16. The method of Claim 1, wherein depositing aluminum comprises depositing aluminum by CVD until the recess is filled (Col.4, lines :40-50).

17. The method of Claim 1, wherein depositing aluminum comprises: depositing aluminum by CVD to form a seed aluminum layer in the recess (wetting layer); and sputter depositing aluminum on the seed aluminum layer in the recess (wetting layer); and wherein the method further comprises reflowing the deposited aluminum in the recess (Col.5, lines: 45-56).

18. The method of Claim 1, wherein plasma treating the substrate comprises plasma treating the substrate under conditions sufficient to cause aluminum to deposit at a greater rate on a portion of the metal-containing layer within the recess than on a portion of the metal-containing layer adjacent the recess (Col.8, lines: 20-45).

19. The method of Claim 1, wherein the recess comprises one of a hole, a trench, a groove or a step (Col.7, lines: 25-30).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Lee et al ('769).

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In reference to claim 11, Lee fails to explicitly teach the power level of the plasma treatment as being in a range of 600 to 1000 W.

However, the selection of the power level is obvious because it is a matter of determining optimum process condition by routine experimentation with a limited number of species. In re Jones, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious) and In re Boesch, 205 USPQ 215 (CCPA 1980)(discovery of optimum value of result effective variable in a known process is obvious).

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Laura M Schillinger whose telephone number is (571) 272-1697. The examiner can normally be reached on M-T, R-F 7:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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LMS

A handwritten signature in black ink, appearing to read "Laura M. Hahnel". The signature is written in a cursive style with a large, looping "L" and a long, sweeping underline.

11/27/04